SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

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THE ST. LOUIS MEETING.

LOCAL arrangements have now been nearly completed for the St. Louis meetings, beginning with December 28 and running through convocation week. With the exception of the address of President Remsen, on Monday evening, for which the Odeon—a large hall near at hand—has been secured, and possibly one or two other public evening lectures, all the meetings will be held in the Central High School. This is a modern building with good internal arrangements. It is situated on Grand Avenue between Bell and Fimney Avenues, with convenient car service to the residence and business districts of the city. Ample rooms for all the sections of the American Association and for the affiliated societies are provided, and a suggestion made in SCIENCE early in the year has been acted on by furnishing each section with a lounging room, adjoining its meeting room. The officials of the board of education have cooperated with the principal of the school and the local committee in adapting the rooms to the purposes of the meeting by substitution of seats for desks in many rooms, and by the

provision of comfortable arm-chairs in the lounging rooms.

Hotel headquarters of the American Association and of several of the affiliating societies have been placed at the Southern Hotel; others will be at the Planters House, and still others, doubtless, in other down-town hotels—the disposition, apparently, being to centralize hotel headquarters, as the meeting places are centralized, even though but a part of the expected members can be accommodated in a single hotel at the holiday season when the hotels of a commercial city are most crowded because of the influx of traveling men who at other times are distributed over the country. The local committee, however, promises ample and good accommodations for the largest number who can attend the meetings, and have secured reasonable and in most cases reduced rates for the occasion.

The railroads promise the customary rate of one and one third fare for the round trip, from all parts of the country, on the certificate plan.

So far as can be judged from the information now in hand, the sections of the association and of the affiliating societies will have full and attractive programs, so arranged as to prevent the simultaneous presentation of papers interesting to the members of different organizations standing for similar divisions of sciences; and a little conference between the various secretaries and arrangement with the local secretary will readily ensure the entire absence of this disturbing feature of some meetings.

Sessions for the most part are limited to morning and afternoon hours, a lunch being provided in the school building by the local committee for every day but Thursday, when, after the noon adjournment, members will go to the exposition grounds, where they will be given a buffet luncheon by the exposition authorities and afterwards, in parties of convenient size, shown through the buildings by the chiefs of departments, under whom the exhibits are in process of installation. Not the least part of the interest in this afternoon will lie in the opportunity to inspect the magnificent new buildings of Washington University, which are to be occupied at the close of the exposition.

Some unusual degree of care has been taken to prevent a clash of interests in the evenings of the week, Monday evening being reserved for the address of the retiring president, Dr. Remsen, and the other evening events, so far as the local committee could adjust them, being placed with this end in view.

One advantage—or disadvantage—of meeting in convocation week is that the diversions and hospitalities incident to a meeting in the summer vacation are not possible. The local committee, however, has studied to provide for their scientific guests all the opportunities that can be utilized for seeing the interesting features of St. Louis and testing the hospitality of its citizens; and it is probable that the various secretaries will so adjust their programs as to make it possible for members to see what they care to see of the engineering, chemical, manufacturing and scientific sights of the city.

In the way of specific diversions, aside from the visit to the World's Fair, may be noted one or more evening lectures of general scientific interest, the annual dinners of the American Society of Naturalists and the Sigma Xi Honorary Scientific Society, each followed by an address by a prominent speaker, and the annual banquet of the trustees of the Missouri Botanical Garden, which is one of the notable events of the year, and for which personal invitations will be extended to as large a number of the distinguished guests of the city as can be provided for.

These statements should make clear that provision has been made for one of the most successful and one of the pleasantest meetings of the American Association for the Advancement of Science and the American Society of Naturalists, with the many organizations that meet in affiliation with them; and the members of the bodies that are to meet in St. Louis should at once put their respective secretaries in possession of titles and abstracts of the papers that they propose presenting, so that the detailed programs may be prepared in the best manner.

In addition to the sections of the association, all of which except Section K are to meet this winter, the following affiliated societies are to hold meetings in St. Louis during convocation week: The American Anthropological Association, The American Chemical Society, The American Mathematical Society—Chicago Section, The American Microscopical Society, The American Physical Society, The American Psychological Association, The American Society of Naturalists—and with it the Central Branch, The American Society of Zoologists—Central Branch. The Association of Economic Entomologists, The Association of Plant and Animal Breeders, The Astronomical and Astrophysical Society of America, The Botanical Society of America, The Central Botanists' Association, The Fern Chapters, The Geological Society of America, The Sigma Xi Honorary Scientific Society, The Society for Horticultural Science and The Society for the Promotion of Agricultural Science. The Botanical and Entomological Clubs of the association will also meet informally at times that will not conflict with the corresponding sections.

In our next issue the details of the arrangements for the meetings will be given, and the preliminary announcement, which will be mailed to members about the first of December, will contain full information as to hotels, railroad tickets, etc.

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*SCIENCE AND MEDICINE IN THE MODERN UNIVERSITY.**

BELIEVE me, it is a difficult thing for a stranger, even at your invitation, to address you on an occasion like the present. So many significant events crowd in upon him and time for reflection is needed to weld into a connected whole the impression he would wish to offer to you. Not that the growth and doings of this university have not been followed and watched with interest by us in the old country. On the contrary, your activity has been felt, not

* Address given at the formal opening of the new laboratory for physiology, pathology and medicine of the University of Toronto, on October 1, 1903.

only as a matter of mutual congratulation, but as a spur to arouse us to effort in our own similar pursuit of educational aims. But the stranger coming among you necessarily feels the shortcomings of his acquaintance with the details of these academic enterprises you have taken in hand. One advantage, however, is his. His view, gained from a distance, necessarily has freedom and truth of perspective that may give it a value in your eyes.

Some things lose by perspective. Some things, imposing when seen close to hand, dwindle when viewed from afar. Not so Canada. The perspective given by the width of the Atlantic is but an appropriate setting across which to view her greatness and her far-reaching activity. And this event, this academic celebration, this *dies festus,* in your university to-day, retains from afar off all the significance of a great event. It loses no tittle of its dignity and import when viewed across ocean from the crowded turrets of the older Cambridge, or the hoary spires of Oxford. It shines, I assure you, like a beacon to the new university whose buildings are as yet unfinished on the hill above the port of Liverpool.

Coming from a region where history is long and the land little to this where written history is short and the expanse of land incomparably great, one realizes how relative is size. And in regard to the event of to-day the largeness of this country rises in my thought not as a matter of mileage, but—that with you more than with us in the old country, the size of to-morrow is vaster than the size of to-day. Each step of progress here, more than with us, has to be measured by its ample consequences in a more rapidly widening horizon of the morrow. These new laboratories have a field already demanding them, and a still larger lies before them in an immediate and historic future.

Biology is the study of life in regard especially to growth and organization. Every medical man is a biologist, and as a biologist it may be but natural if I regard to-day's event from a biological standpoint, and the community as an organism, and the university as a living organ, essential to the healthy life of the community.

Science—especially medical science—is growing in importance to the community. We must have organization in science as in industry. This university to-day makes provisions of first-rate importance for the organization of medical and allied sciences in the region which centers here. Capacity to rear and support men constitutes the extent of a country, and population is the biological measure of the social organism. The ceaseless energy of the race has begun to plant a great population in this land. Growth, great and rapid, is inevitably before it. The growth of nations as of individuals requires the vigilance of guiding hands. Growth, for it to take its course rightly towards perfection, requires that provision for the security and expansion of the liberal arts and sciences forerun rather than halt behind the actual requirement of the hour. It is not only for their direct utilitarian service. They form a whetstone for man's most universal tool, his intellect, also a discipline for character, in the pursuit of truth for its own sake. Scientific truth, when found, has often proved unpalatable to man, as when it dethroned him from his fancied seat at the center of the whole perceptible universe, a universe he had imagined simply subservient to his needs; or again, as when it taught him that instead of being a creature altogether apart from the brutes, there are flesh and blood bonds between himself

and them. Regardless of its cost to his cherished fancies, man strives for scientific truth. And, as the old Greeks said, this purpose puts him further from the brutes and nearer to the gods.

In nurturing science I would urge that a community cultivates more than mere utility. And even with regard to mere utility, as the fields of knowledge fall ripe under the ceaseless husbandry of the world's thought, those who would join in the great reaping, and not only glean where others reaped before them, must cultivate for themselves. To do this requires more than the devotion of individuals. It requires the intelligent cooperation of whole groups of individuals. Organized scientific inquiry becomes in advanced countries a conscious aim of the community as a community.

That society may draw due benefit from wells of natural knowledge, three kinds of workers have to stand side by side. First, the investigator, who, pursuing truth, extends discovery, with little or no reference to practical ends. He constitutes the fountain-head of the knowledge that is for distribution. Other hands may reap the harvest, but his set and rear the seed.

After the investigator comes the teacher. To him it belongs to diffuse the knowledge won. This honorable and difficult task receives its best reward in seeing the small spiritual beginnings of a pupil widen into the spiritual beginnings of a master. Thirdly, there is the applier of natural knowledge. His part consists in making scientific knowledge directly serve practical needs. It is this work which to the popular idea often represents the whole of science, or all of it that is commonly termed 'useful.' The practical results of this work are often astounding to those ignorant of the steps by which they have been reached. The greatest of these steps, however, is usually the first one, made in the laboratory of the investigator. These three coworkers are coequal in the priesthood. Science and the applications of science are one growth, united together even as the fruit and the tree. The proper hearthstone round which the community should group these laborers, laboring for a common end, is the university. There the sacred flame of learning is fed from many sides by many hands.

It is sometimes said that pursuit of science renders a man deaf to the appeals of practical life. That it tends to withdraw him from the everyday interests of the people. That I do not believe of any science, certainly not of biology and the medical sciences. From their very outset these subjects draw the mind toward study of an organization the most complex and the most perfect it can examine. The ancient simile that our school classic, Livy, drew between the human body and the body politic, the state, has not lost but won significance as the centuries have run. The achievement of the microscope has been the discovery that living things, whether plant or animal —all living things of more than minutest size—are commonwealths of individually living units. These cells, as they are called, are living stones that build the house of life. In that house each stone is a self-centered individually living microcosm individually born, breathing for itself, feeding itself, consuming its own substance in its living, and capable of and destined for an individual death. Each cell lives by exchanging material with the world surrounding it. In other words, its bulk depends on its surface. Hence, surface increasing as the square and volume as the cube, cell-size is circumscribed by tiny limits—microscopic limits. Had the dependence been greater than it is, and the average size of the cell less, and too small for resolution

and discovery by the microscopes of seventy years ago, it is hard to imagine where biology would stand to-day. For two generations every biologist has been accustomed to think in terms of the cell theory. Every shred of the body he knows as an intricate interlacement, embodying cooperation and mutual support of associate thousands of individually existent cells. Division of labor has gone on, and with it differentiation of structure; while this group of cells combines with its own inner life some special function subservient to the needs of the great commonwealth as a whole, another group is specialized for another duty again subservient to the general needs. Each organism, however complete its solidarity, each one of ourselves here, is built up of living myriads. Each such organism consisted at its outset of but a single cell, and from that in his life's growth have arisen the countless myriads composing him to-day. The blood relationship is close between all the cells of each individual body. The cells of our nerves, of our muscles, of our lime-hardened bones are all blood relations through one common ancestor. Yet so far has specialization of these unit lives gone on, so far does function reflect itself in microscopic form, that there is greater likeness between my nerve-cells and the nerve-cells of a fish than between my nerve-cells and my own muscle-cells—despite the blood relationship between these latter. And in the commonwealth of cells that constitute each one of us, goes forward day long, night long, as in the body politic, the birth of new units to replace the ones outworn, the subordination of many individual purposes to one, the sacrifice and destruction of the individual life for the benefit of the many.

Trained in study of such an organism, surely the biologist and the medical man will be the last to underrate the importance of organization to the community for the common weal. Therefore I am rejoiced, but I am not surprised, that it is your faculty of medicine which to-day, in its public-spiritedness, erects and instals these fine laboratories, this potent addition to the organization of your community, for its activities in medicine and biological science. I would also, as a friend among you, offer you my congratulations on the consolidation of your two schools of medicine. Union means not only greater strength, but the more effective application of that strength.

I need not to this assembly extol medicine. Many of her votaries are here; I venture to count myself as one. But to-day the relation toward her of education is a matter on which our minds are naturally set. Am I wrong if in regard to this it rises saliently to me that from the educational standpoint medicine, like Janus of old, in a good sense, bears a double face? On the one hand, she is an empiric. She has learned to cure by what the comparative psychologist calls the 'method of trial and error.' Her conquests over sickness were acquired purely as result of experience, without help either from a priori or from inductive reasoning. And great and glorious is the rôle of her achievement on these lines. Of her humanitarian triumphs probably still—certainly until a generation ago—the greater share is assignable to this part. The use of quinine in malaria, the curative effects of the iodides and various metals, the discovery of chloroform and ether as anesthetics, these and the names of a long line of famous physicians from the renaissance down to some as justly famous as the past, and with us now to-day, suffice to certify the inestimable gifts that medicine as empiric has given to mankind in his suffering. This face of medicine may well wear a garland.

In her other aspect, medicine is not an empiric, but a scientist. Who will refute

me if I assert that medicine is as well as an art a science? Somewhere it is said that woman is the last thing that man will ever civilize. So the scientific aspect, the male face of two visaged medicine, thinks of that female face, the empiric, with whom his lot is linked. He feels sometimes that his other half is the last thing science will ever render wholly rational. By dint of patient toil he improves her practice by showing her a reason now and then. No sooner is that done than she is off on a fresh flight into the inexplicable, and he must cudgel his brains anew to find her a fresh logical position.

The feminine, ever youthful trait in medicine has to the student an undying charm. But, on the whole, the countenance of medicine has of recent years, for the student, become masculinely severe. This masculine head of medicine has indeed become the larger. Hydrocephalic in appearance though it may be, it is filled, not with water, but with reasoned facts. The development proceeds in the main from certain data acquired in the century just passed. For instance, the chemist, in discovering that all the million-sided chemical diversity of the perceptible universe is composed from a few—some seventy—substances, therefore called elemental, discovered also that living matter, instead of containing elements different from and subtler than those of the dead world, consists of just a few of the very commonest of those same ones. Further, the doctrine of the indestructibility of matter was demonstrated in a new form, namely, as the indestructibility of energy, and the convertibility of any one form of energy into other forms. Thus dead and living matter became united as subject material for study. It became really possible to consider the living body as a chemical and physical machine, a machine to which the laws of chemistry and physics can be applied.

But this scientific progress in medicine, fruitful of benefit to the community, lays on the community a burden of obligation. The empirical part of medicine is at once the most easy and the most difficult thing to teach. The preparation for learning it requires but little training in other subjects. Its facts lean on nothing but themselves.

With the scientific part of medicine it is different. That is based upon initiatory studies. Medicine, historically traced, we find first drawing help from the simplest and nearest at hand of these adjuvant studies. First she bent to the study of the gross form of the parts and organs of the body. The gross form of these is significant chiefly where they are machinery for application of mechanical powers. The greater part of the corporeal machinery is, however, not destined for such work, but has its purpose in processes chemical, thermal and electrical, to which—marvelous appendage—mentality is adjunct. Medicine in the course of the seventeenth and eighteenth centuries sucked dry for the most part what the study of the gross form of the body's parts could yield her. She then turned to the study of microscopic form—examined what Bichat first named the tissues, the fabric of the body. In so doing she came upon a great generalization, the cell doctrine, discovering an essential and visible similarity of microscopic structure in all that has life, differentiating it from all which has not life.

But even before the advent of the cell theory, medicine had begun to ask of chemistry what it could give her. With the discovery of oxygen and of the nature of combustion the links between biology and chemistry began to be tightly drawn. The young Oxford physician, Mayow, had performed the fundamental experiments on respiration and had discovered oxygen more than a century before Priestley and Lavoisier; but the time was not ripe until

the stupendous work of Lavoisier had founded modern chemistry. The cell theory was from the first not only morphological but physiological. It meant for the application of chemistry to biology that the chemistry of the body or of one of its organs was a chemistry resultant from a thousand tiny living furnaces, individual seats of oxidation, deoxidation, polymerization, hydrolysis and what not.

Not only that, but the living laboratory of the cell itself manufactures even the medium in which the cells themselves exist: the saps and juices of the body. And we are beginning to know, thanks to pathology, that every species of animal produces an internal medium specific to itself. Further, your distinguished physiologist here, Professor Macallum, who has so revealed the distribution of the chemical elements within the cell, tells us that the internal medium which the cells of even the highest animal forms produce as appropriate for themselves, still approximates in its salts to the water of the ancient geologic seas in which their ancestry arose, and still reveals in fact the composition of that ancient ocean. In that respect these living cells, with all their influx of change, have been more durable and constant even than ocean itself. The contrast brings home to us a deep distinction between dead matter and living—the latter a moving equilibrium, gaining stability from the very motion of itself.

By Schwann and by Pasteur the bonds between chemistry and medicine were drawn still tighter through discoveries concerning those subtle influences named 'ferments.' Pathology, the study of these processes of the body in disease, even more than physiology, as yet, has drawn help from this part of modern chemistry. If the processes of health are in fact the resultant of the due cooperation of ten million little foci of healthy chemical action in the body, the processes of disease are similarly divisible, and have to be traced to the unhealthiness of certain of these minute centers of activity. How extreme is the importance of chemistry to modern medicine, no single statement can perhaps emphasize so well as this—that is, I believe, acknowledged on all hands—that in virtue of his chemistry, a chemist, Louis Pasteur, during the latter half of last century, was able to do more to alleviate the diseases of mankind and animals than any physician of his time.

To the physicist also medicine has made appeal. From him she has got understanding of the body's heat, the basis of the knowledge of fever; she has learned the intricacies of the mechanism of the eye and refined methods of examining that organ and of remedying many of its defects; the laws that govern the circulation of the blood and the subtlest means of detecting the forces liberated in the working of the nervous system. In some cases, as sciences grow, their discoveries seem to sunder them the further one from another. In my belief, that merely shows they are then at the outset of their career. To-day we find physics and chemistry converging and conjoining within a field of physical chemistry. It early became convenient to have a specific name for living material, wherever found. The name given was protoplasm. It might have been better to call it x or y, so far was it in many respects an unknown quantity. Instead of looking forward upon this material as a chemical entity, we incline now to regard it rather as a field for chemical action satisfying certain particular conditions. Probably discoveries regarding these conditions will fall to the physical chemist, perhaps in a future very near at hand. Probably such discoveries will be among the most valuable that medicine has yet received from any source.

I have said enough to remind us how interlocked with science medicine has become. She is applying sciences to her own problems, and they form a vast capital fund from which she can draw wealth. To give instruction in this part of medicine, to turn out men trained in it, is now one of the duties of a medical school. The earnest student has a right to expect such training from his alma mater. But for it the requirements are importantly different from those that suffice as an introduction to empiric medicine. In the first place, as Pasteur said, we can not have the fruit without the tree. For scientific medicine the student must, perforce, be thoroughly trained in his sciences before he can really grasp instruction or truly profit from his medical teaching. One of the aims of his instruction in empiric medicine is to teach him to observe for himself; so in his instruction in scientific medicine, one of its aims is to enable him to apply science for himself. How small a fraction of all the realities of medical practise can be met in the few years of preparation of the student in the clinic as he passes through it in his school career! His teacher knows that well, and uses the cases there as types whereby the principles of medicine can be fixed as a beginning. The rest must be accomplished by the man himself, as his life's work. It is necessary that the student go forth from his school equipped not only with the present applications of science to disease, but so possessed of root principles of the sciences adjunct to medicine that he may grasp and intelligently use the further developments of scientific medicine after he is weaned from his instructors and the school. That is a way to obtain enlightened progress in professional practise. What truer safeguard can a man have, alone it may be, and isolated from the centers of knowledge, what truer safeguard can he have against all the pseudo-scientific quackeries of the day, than some real knowledge of the principles of the sciences, along whose lines the discoveries of medicine must develop?

Therefore it is that the burden of obligation falls heavily nowadays upon the teaching resources of every faculty of medicine worthy of the name. There is, in the first place, the burden of increased intellectual labor. Both for the learner and the teacher is this true. To seize the proffered assistance of these great and complex sciences is not always easy. These studies are more difficult than those that were needed once, and they take longer to acquire. The mere instrumentarium of modern chemistry and physics, as applied to medicine, and of physiology and pathology, and bacteriology, of itself suffices to bring conviction of the increased difficulty and longer training due for these studies now preparatory to medicine.

Further, these initiatory studies have become vastly more costly than was all that formerly was required. Experts have to be found who can devote themselves heart and soul and undividedly to their particular subject. Laboratories have to be erected and equipped, and on a scale that makes them a distinct feature of the modern world. Those that we see now here are models of their kind; wise foresight has planned them; public-spirited enterprise has constructed them accordant with that plan. Nor does the achievement end with their erection. The laboratories and their equipment are but the factory and the plant; both fail in their purpose if they halt for sustenance. And beyond that the likeness does not go. The factory, once started, if it be wanted, can expect to pay, to support itself. Not so the laboratory. The laboratory is both a school of instruction and a school of thought. Well, then, no higher instruction can be expected unaided to pay the expenses it

involves; it can only do so at the expense of those who come to learn, and that is to put its teaching beyond the reach of all but the wealthier few. And the instruction is costly, for it has to be practical. And another source of expense is that the laboratory has not only to distribute knowledge, but to manufacture it. The duties of a university do not begin and end with the disciplinary and didactic. Besides schools of instruction, they must be schools of thought. To be this latter, the laboratory must pursue research. Even for the welfare of the class-teaching this is essential. Instructive lectures may be given by men of ability, the whole of whose knowledge is second-hand, but it is doubtful whether the real life of science can be fully felt and communicated by one who has not himself learnt by direct inquiry from nature. Nothing more augments the teacher's power of impressive and incisive teaching than to have faced problems of his subject himself as an original enquirer. And, after rudiments have been once fairly acquired, there is for good students no training equal to that given by following even a small research under an experienced leader.

So truly does the laboratory become a school of thought. The student should enter on his study of a natural science through the portal of its fundamental experiments. The attitude his mind thus takes is the true one—the only true one—for further insight into the subject. Too often humanistic studies at school have tended to kill the natural philosopher within the child—to destroy that innate curiosity for facts, the healthy heritage of childhood. He leaves school a little book-man. Even as to the phenomena of nature, he has been insensibly led to ask for statements upon authority, rather than to turn his own senses and observation to the phenomena themselves. To learn a science or acquire an art resting upon sciences, the first thing to do is to look at the fundamental facts for oneself. Our great teachers of medicine teach upon this plan. They teach where they learned, not in the library, but from the bedside of the sick. In laboratories such as those raised here for pathology and physiology and hygiene students can learn these sciences as medicine is learned in the hospital ward by direct inquiry into nature. The teachers you give them are men who have won widely recognized distinction as themselves direct enquirers into nature. Worthy students will appreciate the double boon their alma mater gives them—the means of learning at first hand those secrets of nature which lie at the root of their craft's skill—and to learn them under guidance by men who excel in unraveling such secrets.

Only by enabling men to continue their learning after their teaching is over can we secure the greatest advantage any educational system can afford. Your laboratories here will encourage post-graduate work. We look with keen interest to the researches that will flow from them. No subjects offer finer fields for research than do the progressive studies, physiology, and pathology, to which your new university buildings are consecrated. And of the functions of a laboratory, research is not the least costly. We in the old country find that. Our central government has done little to support research. Our nation, proud of its success in things practical, has been prone to despise the abstract and the theoretical. We do so foolishly; we do so at our peril. Behind all practical application there is a region of intellectual action to which, though our practical men have contributed little, they owe the whole of their supplies. Theory, if a goose, is the goose of the fairy tale that lays the golden eggs. No more such eggs if once you let her die. To speak of theoretic

knowledge slightingly is for the lips of the fool. The value of abstract research to a country is becoming more widely acknowledged among us than it was. Sir John Brunner said the other day, at Liverpool, that there was no better investment for a business man than the encouragement of scientific research, and that every penny of the wealth he possesses has come from the application of science to commerce and to manufacture. And we find that munificent citizens have and do come forward among us and meet by their individual gifts, the pressing needs in this respect of our community at large.

But we welcome a new era dawning on us. Liverpool, Birmingham, Sheffield and other great centers begin to regard the local university as an institution entitled to support from the public means, for instance, by subsidy from public rates. Such subsidies can be used also for studies which do not come within allotment from the smaller subsidy from the central government: medicine, for instance. Proud of the young universities—to which yours of Toronto is a time-honored veteran—communities and local governments are encouraging research within our universities. They do not expect such research to be able to pay its own way, but they recognize that indirectly it does pay the community that gives it a home. They feel it a duty which they owe themselves. Is not the university a part of their own life, and is not research a part of the university's life-blood? They feel it a right, due to their own higher selves. It stimulates progress. Supported by the large-handed sympathy of the community and the local government, it means quicker advance, both material and mental, it means invention, and it means medical discovery. And *qui facit per alium facit per se*, is a motto worthy of a state.

What, then, are finally the uses of these laboratories now opened by your university? They will assist in training men for various honorable callings, especially for that most ancient one of medicine. They will assist, no doubt, also to render life by practical applications of science still more different from what it was only a short generation ago. They will assist to bring home and distribute to your community treasures of knowledge from all the quarters of the globe. They will assist—and it is thought dear to a high-spirited people—to add, by their own contribution, to the sum total of the treasures of knowledge of the whole human race. *'Noblesse oblige'* appeals not only to chivalrous individuals but to chivalrous nations.

Yet their highest office seems to me, perhaps, not even these high ones, but a more difficult still. Genius can not by any community, however wealthy and powerful, be made to order. In biblical language, it is the gift of God. All a community can do toward obtaining it, be our riches and willingness a thousandfold what they are, is to ensure the rare and glorious plant a meed of freedom, light and warmth for blossoming upon our soil. Who can doubt that in this population here genius exists—not sown, it is true, broadcast, for nowhere is it thus—yet existent, scattered up and down? This it is for the community to foster, to discover.

By the help of these finely built and finished laboratories this much in one direction can be done. The problem to which a wise country turns is the discovery less of things than of men. By these laboratories, adequately supported, your community can create opportunity for the exercise of powers which come from sources within itself, but are utterly beyond its power to produce at will. Their loftiest function is creation of this opportunity. For that aim the studies in them must be followed with no single narrow technical purpose, but must be wide of scope and free of access

to every rank of students. So shall these laboratories prove a corner-stone for the upbuilding of a temple of knowledge, and a touchstone for the best ore of intellect in all the width of this great land.

C. S. Sherrington.
University College, Liverpool.

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*THE NEW AGRICULTURAL EDUCATION.**

There is now largely increased interest in agricultural education in all parts of the country. This is due in large measure to a radical change in the foundations of the system of agricultural education. In the past the courses of instruction were based on the sciences related to agriculture, whereas now they are being based on the science and art of agriculture itself. Owing chiefly to the researches of the agricultural experiment stations and kindred institutions in this country and abroad, there is now a distinct body of knowledge which may fairly be called the science of agriculture. This science treats of the production of plants and animals useful to man, and the uses of such plants and animals. It is divided into plant production, which includes agronomy (field crops), horticulture and forestry, zootechny or animal production; agrotechny or agricultural technology (including dairying, sugar-making, etc., adulteration of foods and feeding stuffs, etc.); rural engineering and rural economics.

This fact has lately been recognized in the reorganization of the United States Department of Agriculture, where we now have Bureaus of Soils, Plant Industry, Forestry and Animal Industry, in which are grouped a large number of scientists representing various specialties in agricultural science. These men now feel that they are working primarily as agricultural scientists rather than as botanists, chemists, physicists or physiologists. Their natural outlook is, therefore, in the direction of promoting the advancement of agricultural science and practise, and they are disposed to lay under contribution every science required to work out the complex problems of agriculture.

Many of our agricultural colleges are also being reorganized on this basis. A notable illustration of the results is found in the Illinois College of Agriculture, where there are now twenty men teaching different branches of the science of agriculture and the number of students has increased tenfold in four years.

While the number of students in the agricultural colleges has been relatively small, they have done a great work. From them have come in large measure the men who have made the science of agriculture, who have manned the experiment stations, who have brought about changes in our agricultural practise which have largely increased production, and, what is more important, have set our intelligent farmers on the highway of rational progress. These men have also laid the foundations for a system of agricultural education which is already affecting the thought and activity of hundred of thousands of farmers who never have been on the campus of an agricultural college, and which in the not distant future will directly touch the masses of our rural population.

For the leaders of our agricultural progress have learned, and the general public will soon learn, that the agricultural college is not the only institution required to give us a thoroughly effective system of agricultural education. And already representatives of the different institutions comprised in a comprehensive system of agricultural education are actually in operation in different parts of the country, so that we can now clearly understand what the American

* Summary of address at dedication of new agricultural building, New Hampshire College of Agriculture and Mechanic Arts, October 28, 1903.

system of agricultural education is to be. Briefly outlined this system will include: (1) Agricultural experiment stations (*i. e.*, institutions of research), (2) graduate schools, (3) colleges, (4) secondary or high schools, (5) special schools (of dairying, etc.), (6) elementary courses in the common schools and (7) extension work, especially farmers' institutes.

Emphasis must be laid on the research work of the agricultural experiment stations, for on their success depends not only the advancement of agricultural practice in particular regions, but also the effectiveness of the agricultural colleges and other institutions for agricultural education. For it is the new knowledge which the stations are gathering through their researches that is required to strengthen and develop the courses of instruction in agriculture. These stations are the fountains from which will flow the streams of knowledge that, on the one hand, will make our farms more productive, and, on the other, will give our youth sound training in the correct principles of agriculture. It is gratifying, therefore, to observe that in the building which we dedicate to-day distinct provision is made for the work of the experiment station.

The courses of instruction in an agricultural college may easily be so grouped that the graduate in agriculture may have a truly liberal education. This is well illustrated by the course of study proposed for our agricultural colleges by standing committees of the Association of American Agricultural Colleges and Experiment Stations. This four-year course includes English, modern languages, psychology, ethics, political economy, general history, constitutional law, drawing, algebra, geometry and trigonometry, as culture studies; next there are the pure sciences—physics, chemistry, botany, zoology, physiology, geology and meteorology; lastly, the vocational studies—agriculture, horticulture and forestry, veterinary science and agricultural chemistry. As regards the time assigned to these subjects, we find two thirds of the entire course is occupied with culture and scientific studies, leaving one third of the time for agricultural science and its applications to the arts of agriculture.

It should be clearly understood that the agricultural college course leading to a bachelor's degree will call for an amount of learning which can only be acquired by years of close application to study. It is therefore not for every boy, any more than any other college course, but only for those whose ability and tastes shall lead them to devote themselves to a large educational effort. As managers of our larger agricultural enterprises, investigators, teachers, journalists, government and state officers, manufacturers of fertilizers, farm machinery and other products resulting from or used in agriculture, we need in the aggregate a large number of men who have received thorough training in the science and art of agriculture. These men should be trained in our agricultural colleges and should at least attain the bachelor's degree. Already there are profitable employment and honorable careers for more men of these classes than our agricultural colleges can supply, and the demand for these graduates in various capacities is rapidly increasing.

The colleges must also help to organize the lower grades of agricultural education. In many of our states if there are to be successful schools of dairying, horticulture, forestry or any other branch of agriculture, they will have to be organized as a part of the agricultural college. And the same is probably true of the agricultural high school. Such an institution is the crying need of our rural communities. When the farm children are through with the district schools they should not be compelled to go

to town or city high schools where agriculture is entirely neglected. They should be provided with schools similar to the manual training high schools maintained in many of our cities, in which, along with culture and scientific studies, the theory and practice of agriculture shall be systematically taught.

It may, perhaps, be said that this is a large and expensive program. But agriculture is making no unreasonable demands. She is asking only the same treatment which is already accorded other arts and professions. The clergymen, lawyers and doctors receive their education very largely at public expense. Schools of technology and courses of manual training are being rapidly multiplied as parts of our public school system. The city schools in ever-increasing measure directly prepare their pupils for the pursuits of urban communities. The farmer is not to be deprived of similar privileges along the lines of his art. The republic can not afford to maintain the great fundamental industry of agriculture on the basis of ignorance and conservatism. Reckoned at their lowest value, the public funds spent in technical education, whether in engineering, trades or agriculture, are a most profitable financial investment. But they pay vastly richer returns in the broader mental outlook and higher morality of the educated masses.

While acknowledging all this as regards the agriculture of the United States as a whole, some people have had the idea that the agriculture of New England is gradually disappearing and will ultimately be extinct. A most absurd idea! The agriculture of New England has undergone great changes in the past half century. It has passed through a period of depression while the great Mississippi Valley was being occupied and its vast prairies were almost as free as air to the settler. But that day is gone, for the lands of the Mississippi Valley are filled with farmers. Irrigation will ultimately put under the plow millions of acres west of the great river, but this development will necessarily be slow and expensive even with national aid. The natural increase of population, the great tide of immigration, the growing demands of the old world for food to stop the hunger of its teeming millions—all these things are to make our agriculture more remunerative and to bring into more profitable use the lands of New England, as well as of the rest of the country. According to the United States census, in the period between 1890 and 1900 the annual value of the farm products of New Hampshire increased from less than thirteen to nearly twenty-two millions of dollars.

And even now, and in the days to come in far greater measure, it is the trained farmer who will make the best living out of New England soils. For here will flourish an intensive and highly specialized agriculture. The forests are to be reconstructed and profitably utilized as a permanent source of wealth. Horticulture, dairying and poultry raising—pursuits which call for a rare combination of scientific knowledge and practical skill for their most profitable development—are to make the restricted fields of New England far more productive than many broader areas beyond the Alleghenies. But these highly specialized and developed agricultural industries must rest on a basis of scientific and technical education if they are to have great and enduring success. To bring this about is the mission of the agricultural college. It is a great task and a tremendous responsibility. In the older lines of education the college has a quite restricted duty and the methods of its work are relatively fixed, so that its managers and faculty have a comparatively easy burden to bear. But the managers and faculty of an

agricultural college of the present day must not only teach the students whom they can draw into their class-room, but they must also gather out of the realms of the unknown the materials to complete the new science of agriculture on which the scheme of education rests; they must organize and bring into successful operation a whole system of education from the common schools to the university department of research; they must overcome the prejudices and traditions of a most conservative constituency; they must create and develop into active and permanent life a public sentiment which shall result in the adequate equipment and maintenance of a comprehensive system of agricultural education. It is, indeed, a great burden which rests upon the shoulders of this board of trustees, this youthful president and this learned faculty.

But the encouragements to strenuous activity in this cause are also great, for already mighty forces are allied to push on this enterprise. The United States government has pledged itself to the permanent financial support of the agricultural colleges and experiment stations, and is giving them besides the active aid of its great Department of Agriculture. The state of New Hampshire is backing this work with its public revenues, and this building testifies that the state regards the agricultural college as one of its permanent institutions. The workers in the cause of agricultural education here have also those incitements to high endeavor which come from the consciousness of belonging to a great system of institutions, that throughout the length and breadth of the union, and in all the civilized countries of the globe, are competing in generous rivalry for the advancement of fundamental interests of mankind. And what is most significant and stimulating is the sympathetic and active aid of rapidly increasing hosts of intelligent farmers and other public-spirited citizens who individually and through their organizations are helping to make the agricultural college what it should be, and develop a system of agricultural education which shall erelong reach every man, woman and child on the 5,000,000 farms of the United States.

A. C. TRUE.
U. S. DEPARTMENT OF AGRICULTURE.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for October opens with the first of a series of papers on 'Adaptation to Aquatic, Arboreal, Fossorial and Cursorial Habits in Mammals,' the present one being on 'Aquatic Adaptations,' by Raymond C. Osburn. Edwin G. Conklin has a paper on 'Amitosis in the Egg Follicle Cells of the Cricket,' concluding that it is an accompaniment of cellular senescence. Edward W. Berry describes 'New Species of Plants from the Matawan Formation' and O. P. Hay has 'Some Remarks on the Fossil Fishes of Mount Lebanon, Syria.' The concluding paper, by R. W. Shufeldt, is 'On the Osteology and Systematic Position of the Kingfishers.' The number contains the Quarterly Record of gifts, appointments, retirements and deaths.

The Popular Science Monthly for November has articles on 'The Renaissance of Science,' by Edward S. Holden; 'Life in Other Worlds,' by F. J. Allen; 'The New West Point,' by William J. Roe, and a plea for 'A Laboratory for the Study of Marine Zoology in the Tropical Atlantic,' by Alfred G. Mayer, the Tortugas being the locality suggested with Jamaica as a possible alternative. David Starr Jordan discusses 'The Parent Stream Theory of the Return of Salmon,' showing that the evidence is not in favor of it, and J. A. Fleming contributes the sixth of his papers on 'Hertzian Wave Wireless Telegraphy.' Allan McLaughlin shows 'The Bright Side of Russian Immigration,' and Norman Lockyer treats of 'The Influence of Brain-power on History,' presenting arguments for the national support of universities.

The Museums Journal of Great Britain for October contains articles on 'The British Association' and 'The Mannheim Conference on Museums as Places of Popular Culture,' and the concluding portion of the address of the president, which is illustrated by a number of plates. E. M. Holmes has an article on 'The Preservation of Natural Colours in Dried Plants.' There is the customary number of important notes concerning various museums and museum matters.

SOCIETIES AND ACADEMIES.

THE NATIONAL ACADEMY OF SCIENCES.

THE academy held its autumn meeting at Chicago on November 17, 18 and 19. The event was of special importance owing to the fact that the academy has not hitherto met west of the Atlantic seaboard. Chicago has recently become one of the chief scientific and educational centers of the country, and, apart from the program of papers, there was much to interest the visiting members. The members of the academy were very generously entertained by the president and other officers of the University of Chicago and by the director of the Yerkes Observatory. Mr. Alexander Agassiz presided, and the following program was presented:

T. C. CHAMBERLIN: 'Preliminary Report on the Agassiz Data relative to Underground Temperatures at the Calumet and Hecla Mine.'

C. E. DUTTON: 'The Velocities of Earthquake Vibrations and their Significance.'

A. P. MATHEWS: 'The Relation between Solution Tension and Physiological Action of the Elements.' Introduced by C. O. Whitman.

S. W. WILLISTON: 'On the Distribution and the Classification of the Plesiosaurs.' Introduced by T. C. Chamberlin.

C. O. WHITMAN: 'The Evolution of the Wing-Bars in Pigeons.'

CHAS. B. DAVENPORT: 'Evolution without Mutation.' Introduced by C. O. Whitman.

J. MCK. CATTELL: 'The Measurement of Scientific Merit.'

J. STIEGLITZ: 'Stereoisomeric Nitrogen Compounds.' Introduced by A. A. Michelson.

CHARLES BASKERVILLE: 'On the Recent Investigations of the Rare Earths in the Laboratory of the University of North Carolina' (by title). Introduced by Ira Remsen.

E. E. BARNARD: 'Some Peculiarities of Comets' Tails, and their Probable Explanation.' Introduced by George E. Hale.

EDWIN B. FROST: 'Stars of the Orion Class.' Introduced by George E. Hale.

GEORGE E. HALE: 'On the Nature of the Solar Flocculi.'

GEO. C. COMSTOCK: 'The Relation of Stellar Magnitude to Stellar Distances.'

A. A. MICHELSON: 'Spectra of Imperfect Gratings.'

STEPHEN MOULTON BABCOCK: 'The Relations of Weight and Energy.' Introduced by Charles R. Van Hise.

C. S. SLICHTER: 'The Propagation of Ground Water Waves.' Introduced by Geo. C. Comstock.

WILLIAM H. BREWER: 'Biographical Memoir of Sereno Watson.'

CHARLES R. VAN HISE: 'The International Geographical Congress and a Geophysical Laboratory.'

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of October 19, 1903, when, for the first time, the academy met in its new building, Professor Nipher gave a verbal abstract of the results of his paper on the 'Law of Nebular Contraction,' which has just been published in the *Transactions*. He also remarked that the molecular conditions in nebulæ of different gases were being examined, and some very interesting results are at once evident. If a series of nebulæ of various gases have the same mass internal to the same radius, the average molecular velocities would be the same for all gases. The velocity which would enable a molecule to escape from the nebula is 2.71 times the average molecular velocity, and this ratio is constant for all parts of the nebula. If the entire solar system formed the core of such a nebula, and the mass of the solar system extended to Neptune's orbit, the density at that distance from the center of the nucleus would be less than that in a Crookes tube. This opens up some very interesting questions concerning the history of such a mass. It would appear that such a gravitating mass would lose some heat by the escape of the more rapidly moving molecules, as well as by radiation.

Professor Keiser read a paper on a method of determining the amount of free lime in cements. He finds that this can be done by determining the amount of water absorbed. By measuring this absorption in samples containing known amounts, the precautions to be taken in manipulation have been found. The determination only requires about twenty minutes.

Professor Nipher presented a diagram on which was drawn the curve of speed of the trotting horse. This curve represents the equation published by him twenty years ago. On the same diagram was shown a belt of observed values representing the performance of every horse who has broken the speed record since 1845. In some cases a single horse has broken the record several times in the same year. All such observations were included. The points representing these observations formed a belt within which was the curve of predicted speed. The agreement was considered very satisfactory.

AT the meeting of November 2, 1903, Dr. J. A. Harris presented for publication a paper on 'Polygamy in *Solanum*' and a paper on 'The Germination of *Pachira*,' and Mr. B. F. Bush presented a paper entitled 'A New Genus of Grasses.'

The secretary addressed the academy on its past history and prospects, in connection with the occupancy of its new home.

WILLIAM TRELEASE,
Recording Secretary.

THE BIOLOGICAL SOCIETY OF WASHINGTON.

THE 374th meeting, the first of the fall, was held Saturday, October 17.

Under the head of 'Notes' L. O. Howard stated that attention having been drawn to the great variance in the statements regarding the length of the thread of a silk worm's cocoon, he had had the threads of four specimens measured. They were found to be from 880 to 1,102 yards in length, the published figures referred to varying from 1,100 yards to 11 miles.

T. S. Palmer spoke on 'Indexing Scientific Names, with special reference to the Genera of Mammals.' After mentioning the recent appearance of Sherborne's 'Index Animalium,' and the volume of Waterhouse supplementing the 'Nomenclator Zoologicus' of Scudder, he said that for nearly fourteen years past he had been engaged in the preparation of a list of the genera of mammals, living and extinct. This work was to give the date and place of publication, the character and location of the specimen, etymology, and indicate whether or not it was preoccupied. The list, which contained about 5,000 names, was to be arranged both alphabetically and zoologically, so that it would be possible not merely to ascertain whether or not a given name had been used, but to see readily what genera were comprised in any given group. Mr. Palmer then spoke of some of the difficulties that had been encountered in tracing some of the names and their derivation, and said that it was hoped that the list would be issued in December.

O. F. Cook presented a paper on 'Central American Mutations of Coffee,' saying that some of the varieties of coffee were well marked and known by special names. He said that a study of these variations had led to conclusions directly opposed to those of de Vries drawn from observations on primroses; that instead of these variations being natural steps in the evolution of species, they were the result of close inbreeding and indications of degeneration.

W. P. Hay described 'Terrapin Culture in the United States,' giving the results of his observations on the diamond back terrapins in the region of Chesapeake Bay. He gave a résumé of the laws relating to terrapins, intimating that they were the most stringent where least needed and practically not enforced anywhere. The turtles were impounded in large numbers and the eggs were deposited freely and many hatched, but owing to the prevailing conditions and lack of care the larger proportion of young were destroyed. The young grew about an inch during the first year, but attained maturity slowly, probably agreeing in this respect with *Chrysemys picta*. Like this species, four distinct sizes of eggs could be distinguished in the diamond back terrapin aside from the general mass of small,

unfertilized ova. In order to supply the demand for terrapin many were imported from the southern states, including representatives of two distinct and, as yet, undescribed species. It had been thought that these might be crossed with the Chesapeake terrapin, but as none were kept a sufficient length of time, four years, after importation no results had been obtained. Owing to close hunting and disregard of the laws, the Chesapeake terrapin was threatened with extermination, and the simplest remedy suggested was to forbid the sale of the larger terrapins, since these were invariably breeding females.

F. A. Lucas.

THE TORREY BOTANICAL CLUB.

At a meeting of the club held at the Botanical Garden on October 28 the following scientific notes and papers were presented:

Dr. MacDougal called attention to the abnormal fall blooming of certain plants. In one case mentioned the spring flowering of certain plants was retarded till fall, owing to the presence of a mass of ice, this being a case of retarded development. He exhibited plants with flowers now open that should not normally open till next spring, this being accelerated development caused by the prevailing climatic conditions.

Dr. Britton exhibited two forms of the common marsh mallow, one with pink flowers, the other with white flowers with a crimson center. The first is the well-known *Hibiscus Moscheutos* L. The second form is not uncommon in various localities, but has been considered merely a color variation. Recently it has been observed that the fruits of the two forms are very different, showing that they should be considered distinct species. Drawings of the fruits were exhibited. No name has as yet been proposed for the white-flowered form.

Dr. Livingston spoke on the 'Influence of Osmotic Pressure on the Cell.' One of the widely accepted theories of the action of osmotic pressure is that it is comparable to gas pressure. It can only act, however, in the presence of water. Soluble salts tend to diffuse throughout a given volume of water just as gases do in a confined space. In cellular tissues there is no break in the water connection, since the cell wall is permeable by water and by the salts dissolved in it. The protoplasmic lining of the cell is, however, only semi-permeable, since it allows the passage of some substances while preventing that of others. When living cells are transferred from a thin dilute medium to a denser one the tendency is for them to lose part of the water they contain. The cell contents thus become more or less shriveled. Conversely, when a cell is transferred to a more dilute medium it swells and becomes more turgid. Strong solutions tend to check vital activity. Removal to a dense medium often materially alters the form of growth of an organism, the tendency being to assume short thick forms in the dense medium and longer and more slender forms in the dilute ones. With different substances that are not poisonous the cell seems to give the same response when a strength of each is used that would exert the same osmotic pressure, showing that it is the pressure and not the character of the substance that produces the effect. The extraction of water from the cell means the concentration of the solution of all the various salts and other dissolved substances that are contained in it. Varying strengths of the same salt are known to affect the growth of plants very diversely, and this suggests an interesting field for further investigation.

The paper brought out an interesting discussion as to the probable effect on the aquatic vegetation of a gradual change from fresh to salt-water conditions.

Mr. Earle discussed 'Generic Limits among the Agaricaceæ.' He called attention to the artificial character of the genera that are now recognized and the unnatural grouping of species that resulted from the use of only two or three characters as the basis of genera. A more natural grouping would require that the sum total of all the characters should be considered in defining genera.

F. S. Earle,
Secretary.

CLEMSON COLLEGE SCIENCE CLUB.

THE club held its first regular meeting of the present scholastic year on the evening of September 18. Professor W. M. Riggs presented a communication entitled 'The Fixation of Atmospheric Nitrogen.' Priestley's observation of the effect produced in the atmosphere by the discharge of an electric spark was mentioned as being the basis of the present experimental work now being done on this subject. The work now being done at Niagara Falls by Messrs. Bradley and Lovejoy for the purpose of making the process of 'fixation' a commercial success was described in detail. The machines used in the process were illustrated by drawings. The great economic results that would flow from a successful commercial application of the process were emphasized. Professor H. Benton discussed 'Soil Inoculation.' The speaker referred to the fact, long since known, that the cultivation of legumes has always been found beneficial to the growth of succeeding crops. The reasons for this were explained. In view of the fact that each species of legume has its own species of nitrogen-assimilating bacteria, it is necessary that there be present in the soil the particular species of bacteria adapted to the crop to be grown. The different methods of inoculation were described in detail. The speaker closed by giving some figures showing the efficacy of soil inoculation in the case of some hay crops grown in Alabama.

Professor F. S. Shiver read a paper entitled 'The Centenary of the Metric System.' This paper gave in detail the evolution and development of the metric system. Some of the earlier attempts at unification of the French *measures*, prior to the advent of the metric system, were referred to. Picard's work was shown to have furnished the scientific principle upon which the metric system rests. The attempts to legalize the new system in France and elsewhere were recounted. The system was shown to have entered a new phase, that of becoming an international standard, in 1875. The work of the International Commission, as well as of the International Bureau of Weights and Measures, was explained. The methods of preparing the international copies of the meter and kilogram were noted. In conclusion, the work of Michelson in comparing the basis of the metric system with a natural unit, namely, the length of a wave of the red light of cadmium, was referred to. The work of Guillaume on nickel steels and their application to metrology was also mentioned.

F. S. SHIVER,
Secty.-Treas.

CLEMSON COLLEGE, S. C.,
October, 1903.

THE GEOLOGICAL SOCIETY OF AMERICAN UNIVERSITIES.

ABOUT three years ago the members of the Geological Society at Leland Stanford Junior University began considering the possibility of forming a general geological society among the students of the various American universities or schools of mines having efficient departments of geology or mining. A thorough canvass of the situation resulted in the conclusion that such an organization would not only be possible, but most advisable. The Stanford society, acting on this belief, sent letters to the departments of geology or mining at a number of the principal universities, enclosing in each a constitution for a general society which was tentatively offered for their consideration.

Answers favorable to the formation of the general society were received from a majority of the departments addressed, and at two of the universities, where before there had been no such organizations, the students formed local sections. A rather intermittent correspondence between the Stanford society and these two sections and several other local geological clubs followed, but no definite action looking toward the permanent organization of a general society took place.

The matter of such an association now having been more or less favorably discussed at several institutions for the past year or more, the time seems opportune to proceed with a permanent organization. As nearly all the institutions interested now have local clubs or societies, the forming of a gen-

eral society will practically only require the affiliation of the local sections which are already in existence. This may be done by correspondence through the secretary of the originating society at Stanford University.

The desirability of such an organization can not be doubted, as it would form a basis for an acquaintanceship among students in geology and mining which could not but be a benefit and a pleasure to them. The social or fraternal element would be paramount in the general society, but the usefulness of the organization would by no means be limited to this factor. Such an organization would have a wide influence as a medium of exchange of thoughts and ideas among college men interested in geology or mining, both before and after their departure from their alma mater. These are but two of the many advantages which such an organization would develop as its membership and influence grew.

A constitution embodying the organization and aims of a general society has been tentatively drawn up. Its features are, in the main, similar to those common to such societies, and but a few points, some of which pertain more properly to the constitution or by-laws of the local sections, will require explanation here. The name, 'Geological Society of American Universities,' is thought to indicate as nearly as possible the exact nature of the society; and 'section' is deemed a good designation for the local branches. Active membership is restricted to those students whose major subject is geology or mining, and who receive a three fourths vote of the society. Another requirement for membership, which, however, is left optional with each section, but which appears advisable where practicable, is that making it necessary for the candidate to receive a recommendation for good scholarship from the head of his department. It is the history of 'open' societies that sooner or later the interest in them lags; hence, the placing of restrictions on the membership. The society aims to take in only such men as really strengthen it, and to that end have made superior scholarship a requisite. Although practically a senior and graduate society its membership is not so limited, for it is intended to take in men who enter the universities possessing geological or mining experience and are considered otherwise eligible. Honorary and associate members are elected from outside the departments of geology and mining.

The society is a social as well as a technical organization, and in the local as well as in the general organization this fact is well emphasized; the meetings being held for the most part at the rooms or homes of its members. The formal atmosphere surrounding a meeting in a lecture hall or laboratory is thus removed and the effect is most wholesome on the life of the society.

At each meeting some member is assigned to read a paper or give a talk concerning some geological or mining problem; all papers or talks being based on the speaker's own experience or work. Friendly criticism and discussion generally follow each paper, and both the speaker and the society derive much benefit from this informal exchange of ideas. A social hour, interspersed with refreshments, usually terminates the meetings. Open or special meetings are sometimes held at which more formal talks are given, generally by some one outside of the section.

The emblem of the society consists of a design wrought in gold of a miniature geologist's pick, on the handle of which is impressed an irregular gold nugget, bearing in enamel the initials 'G. S. A. U.' The seal of the society is an image of the emblem.

As it would probably be impossible for the society to hold annual meetings at once, temporary provision has been made in the constitution for the transaction of all necessary business by correspondence. The growth of the society, with its ever increasing number of graduate members, would soon make possible annual meetings or conventions, as is customary with like organizations.

The history, objects and a brief outline of the workings of the proposed 'Geological Society of American Universities' has now been given. All that yet remains to be done to permanently establish this society, which surely has a broad and useful existence before it, is for the college men of this country to

enter into it with the zest and interest worthy of the professions represented.

RALPH ARNOLD,
DE WITT C. WILEY.

U. S. GEOLOGICAL SURVEY,
WASHINGTON, D. C., and
STANFORD UNIVERSITY, CALIFORNIA.

DISCUSSION AND CORRESPONDENCE.

THE MEXICAN COTTON BOLL WEEVIL.

TO THE EDITOR OF SCIENCE: In your issue of November 13 (p. 640) you quote from *Bradstreet's* an item regarding the loss to the cotton crop of Texas through the ravages of the Mexican cotton boll weevil. In the course of the article *Bradstreet's* states that six months ago it advocated a careful consideration of the subject by congress. From this quotation alone *Bradstreet's* seems to be singularly misinformed as to what actually has been done by the government, and the quotation will, therefore, mislead your readers.

In 1894 an investigation of this insect was begun by the Division of Entomology of the U. S. Department of Agriculture, and in 1896 and 1897 circulars were published which indicated the great danger to the future of cotton in the United States and proposed remedial treatment. The governor of the state and the legislature were advised by the department of the condition of affairs and the dangerous prospects, and the legislature was urged to pass a crop pest law, the enforcement of which would have resulted in the confinement of the insect to a restricted region in extreme southern Texas, and possibly in its extermination even in that region. The legislation proposed was not enacted. For the past three years the Division of Entomology has been carrying on further investigations through appropriations from congress of $10,000 in the fiscal year 1901–2, $20,000 in 1902–3, and $30,000 in 1903–4. It has resulted from this work that, while no method of extermination has been discovered, it has been demonstrated beyond a doubt that it is possible, even under present conditions and in the worst infested portions of Texas, to raise a fair crop of cotton in spite of the weevil. Experimental demonstrations have been made the past summer on several hundred acres of cotton lands at six stations under the control of the Division of Entomology, and on this controlled land from a half of a bale to one bale per acre of cotton has been already harvested, while in adjoining territory the average crop has not exceeded one bale to from six to fifteen acres.

L. O. HOWARD.

SHORTER ARTICLES.

SOME INSECT REFLEXES.

IN the course of some experiments on the sense-reactions of honey-bees, I have kept a small community of Italian bees in a glass-sided, narrow, high observation hive, so made that any particular bee, marked, which it is desired to observe constantly, can not escape this observation. The hive contains but two frames, one above the other, and is made wholly of glass, except for the wooden frame. It is kept covered, except during observation periods, by a black cloth jacket. The bees live contentedly and normally in this small hive, needing only occasional feeding at times when so many cells are given up for brood that there are not enough left for sufficient stored food supplies. Last spring at the normal swarming time, while standing near the jacketed hive, I heard the excited hum of a beginning swarm and noted the first issuers rushing pellmell from the entrance. Interested to see the behavior of the community in the hive during such an ecstatic condition as that of swarming, I lifted the cloth jacket, when the excited mass of bees which was pushing frantically down to the small exit in the lower corner of the hive turned with one accord about face and rushed directly upward away from the opening toward and to the top of the hive. Here the bees jammed, struggling violently. I slipped the jacket partly on; the ones covered turned down; the ones below stood undecided; I dropped the jacket completely; the mass began issuing from the exit again; I pulled off the jacket, and again the whole community of excited bees flowed—that is the word for it, so perfectly aligned and so evenly moving were all the individuals of the bee current—up to the closed top of the hive. Leaving the jacket off

permanently, I prevented the issuing of the swarm until the ecstasy was passed and the usual quietly busy life of the hive was resumed. About three hours later there was a similar performance and failure to issue from the quickly unjacketed hive. On the next day another attempt to swarm was made, and after nearly an hour of struggling and moving up and down, depending on my manipulation of the black jacket, most of the bees got out of the hive's opening and the swarming came off on a weed bunch near the laboratory. That the issuance from the hive at swarming time depends upon a sudden extra-development of positive heliotropism seems obvious. The ecstasy comes and the bees crowd for the one spot of light in the normal hive, namely, the entrance opening. But when the covering jacket is lifted and the light comes strongly in from above—my hive was under a skylight—they rush toward the top, that is, toward the light. Jacket on and light shut off from above, down they rush; jacket off and light stronger from above than below and they respond like iron filings in front of an electromagnet which has its current suddenly turned on. What produces the sudden strong heliotropism just as the swarming ecstasy comes on? That is beyond my observation.

Dr. Loeb tells me that he has observed and recorded a strong positive heliotropism in the winged male and female ants at mating time. They rush from their underground nest and take wing directly toward the strongest light. With both bees and ants this flying toward the light at swarming and mating time, respectively, has obvious advantages. It keeps the swarm together and it takes them away from the old community. Swarming and mating flights are distribution and migration of the species to new ground where are food and space unneeded by the old community.

During the last three years I have, with a student, Mrs. Bell, been rearing silkworms under quantitatively determined varied conditions of food supply, in an attempt to determine, also quantitatively, the extent and character of the induced variations. In these experiments silkworms separated into various lots (the individuals in each lot kept also apart so that each may get its rightful share of food) are variously fed through their life on an optimum of food, on one half optimum and on a minimum amount, that is, one which will just keep the worms alive, developing and growing. As the optimum amount is that which permits the larvæ to feed almost continuously, and as each under-fed worm eats up as rapidly as possible its full supply, it is evident that the half-fed and minimum-fed worms have to spend long hours of non-feeding, rest and quiet and—if it may be—meditation. Now such a period of non-feeding and inactivity is precisely a normal pre-molting phenomenon of all silkworms—and of other lepidopterous larvæ, too, for that matter. With this in mind it is interesting to note that a common phenomenon in the life of the under-fed worms was an abnormal increase in moltings; that instead of adhering to the time-honored and Bombyx-approved habit of molting four times (exclusive of pupation) during the larval life, most of these half-starved larvæ, with artificially imposed repeated periods of non-feeding, molted five and a few even six times. It may be expected that such a sapping of vitality as these starvation rations must have produced would result in a lessening of the physiological activity, and a giving up of one or more moltings rather than an increase in the number of these betrayals of growing pains. But no, there are more rather than fewer moltings. Now in actual molting, the loosening from the body of the old cuticle results from the secretion by skin glands of a so-called molting fluid; this secretion occurs during the non-feeding resting stage normally immediately preceding the molting. Can the abnormally induced non-feeding, inactive periods imposed on the under-fed worms have been the sufficient stimulus for setting up this secretion and accumulation of the molting fluid resulting, as usual, in a loosening of the cuticle? That is, do lepidopterous larvæ molt not just because molting is needed at some particular time but because the cuticle gets pushed off by a fluid which gets formed and excreted whenever the larva stops feeding? Of course the insect that wisely times its non-

feeding rests so that its moltings shall come to best advantage for the necessities of growth is the insect that is represented by descendants now-a-days. But is molting any the less a reflex for that?

Loeb, in his 'Comparative Physiology of the Brain,' records certain observations on the larvæ of the moth *Porthetria* sp. with regard to their regular movements up the stem of the food plant, suggesting that this climbing up is a positively heliotropic reflex, resulting in the (advantageous) finding of the tender new leaves and buds of the food plant. I have observed the traveling behavior of the larvæ of three species of moths, these larvæ being the mulberry silkworm, a geometer found on lindens and an unknown species (the adult was not bred) which may be called No. 3. In each case only larvæ just hatched from the egg were used, thus eliminating any results of experience or imitation. Twigs of food plants were so arranged that there were for each kind of larva cases in which (*a*) the leaves were up and in the light, (*b*) the leaves were up and in the dark, (*c*) the leaves were down and in the light, (*d*) the leaves were down and in the dark, (*e*) the leaves were in horizontal plane with the twig and in the light, (*f*) the leaves were in horizontal plane with the twig and in the dark, (*g*) the leaves and twig were in horizontal plane all equally illuminated, (*h*) the larvæ were put on a part of the twig which was in the dark, (*i*) the larvæ were put on a part of the twig which was in the light. These various cases were easily arranged for by having a number of hollow cylinders about one and a half feet long, three inches in diameter, and open at both ends. The twig with leaves could be put into or partly into the cylinder, as desired, and the cylinder put in vertical or horizontal position, as wished.

Without taking space to give in actual detail the behavior of the tiny larvæ of the three different species, I may summarize this behavior as follows: The silkworms moved indifferently toward light or away from it, up or down, until they found food, and then made an end of traveling; the linden inch-worms tended strongly to travel toward darkness and when this direction was downward the tendency was greatly strengthened; the unknown No. 3 larvæ tended obviously to travel toward the light, and when this direction was upward the tendency was strongly increased. That is, in these three lepidopterous species, the larvæ of all being leaf feeders and naturally preferring tender new leaves, three different conditions of reaction to light were shown, in one a positive heliotropism, in one a negative heliotropism and in the third sheer indifference to light. This last species, the silkworm, may well be looked on as having lost its earlier sensitiveness to light through panmixia—if there be panmixia—because for generations the silkworm's food has come to him rather than had to be gone to, and there is no more nor better food up or toward light than there is down or away from light or sidewise and in light of the same intensity as that in which he first finds himself. I have reared silkworms in darkness unbroken during their whole life except at moments when the mulberry leaves were thrust into the dark cell, and in no structural or physiological characteristic was there any apparent difference from individuals bred in bright sunlight (alternating with unillumined nights).

It is interesting to note the decided character of the negative heliotropism of the linden inch-worms, as this is the kind of heliotropism which is distinctly unexpected of larvæ which have to find for themselves tender fresh leaves. In a glass cylinder, lighted in its upper half and darkened in its lower half, with linden leaves placed at the very bottom, 92 just hatched larvæ were placed in the lighted half at 11:20 A.M. At 3:30 P.M. 17 larvæ were still in the light half, but 75 were in the lower darkened half, most of them being in the darkest place, that is, at the very bottom *under* the leaves.

Equally marked was the more familiar positive heliotropism of the unknown No. 3. When only two or three inches from leaves put into the darkened half of a glass dish, the whole group of tiny caterpillars, certainly hungry even to death, would keep steadfastly in the light half.

The behavior of these various kinds of

caterpillars, while contradictory if we were inclined to form too hastily a generalization based on the behavior of the *Porthetria* larvæ —a generalization that would explain the going up to light as a reflex which had persisted among all leaf-feeding lepidopterous larvæ because of its advantageous leading of them to the most succulent food—is not at all contradictory of the point of view of the biologist who believes in reflexes. Personally, while still inclined to see more wit in ants than Bethe's extreme confidence in the reflex theory of their behavior would admit, and while recognizing the reasonableness and legitimacy of the query, does the reflex basis of behavior really simplify our conception of the springs of animal behavior?—I am willing, on the evidence of the accumulating observations, to see much of the credit which insects have long enjoyed for the possession of unusual intellectuality and elaborately developed instinct, go by the board. Immediate physicochemical stimuli undoubtedly produce as direct reflexive reactions many of the activities which we have been long interpreting on a basis of complex instincts and associative memory.

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Notes on the Vegetation of the Transvaal.

Before coming to the Transvaal I was informed by a botanist who had some knowledge of the South African flora that the flora of the Transvaal was entirely xerophytic in character, and that it was largely composed of succulent plants—*Euphorbias, Aloes, Mesembryanthemums, Cotyledons, Crassulas* and the like. In my informant's mind it was apparently a continuation of the flora of the Great Karroo.

Imagine my astonishment, therefore, after crossing the Karroo, with its dreary plains so like those of the Great Basin of North America, even in the general aspect and color of its vegetation, to find myself, on waking up one morning, crossing a vast, grassy plateau, the high veldt, practically destitute of trees or shrubs, but producing masses of tall, thick grass, recalling the prairies of the far west. Later I found that this was a fair sample of the vast stretch of country extending from the confines of the Kalahari desert in the west to the summits of the Drakensberg in the east.

Grasses form the most conspicuous features of the Transvaal flora. This is true, at least, of the high veldt. They are only little less abundant in those parts of the bush veldt which I have seen.

Succulents are rare, being practically confined to rocky kopjes, *i. e.*, buttes, and the randjes, *i. e.*, ridges, which cross the country from east to west. Mesembryanthemums are extremely scarce. Bulb and corm-producing plants abound among the grass. A few bushes and small trees, evergreen *Proteas*, caulescent *Aloes* and *Cereus*-like *Euphorbias*, deciduous *Combretums*, etc., also occur on the kopjes and randjes. Patches of diminutive woodland, composed of Doorn-boom (*Acacia horrida*) five to fifteen feet high, are occasionally seen at long intervals in crossing the high veldt, usually in the vicinity of water.

As a rule, however, trees and shrubs are entirely absent. I have driven all day, a distance of sixty miles, without seeing more than one colony of bushes, that composed of about twenty-five individuals in all, and they not more than eighteen inches in height. In the moist vleis, on the other hand, some of the grasses—species of *Andropogon*—would be eight and even ten feet in height. In the absence of woody plants Kaffir and Boer alike fall back on 'mist,' *i. e.*, dried ox-dung, for fuel.

Grasses being, as I have said, the most conspicuous feature of the high veldt flora, one is naturally desirous of knowing what grasses occur, and in particular, which are the most abundant.

Although but little work has been done on the flora of the Transvaal, as compared with that done on the flora of California, for instance, a few good collections have been made, particularly by Wilms Rehmann, Nelson, Galpin and Rand, and sufficient grass material has been gathered by the three first named collectors to give a general idea of the occurrence of the genera. Much still remains

to be done, as my winter's collection of grasses shows, in working out the distribution of genera and species and the relative abundance and economic value of species and individuals. It is almost inevitable that a large number of additional species and some genera will be found, for whole districts of great size and varied climatic and edaphic conditions remain wholly untouched by the botanist.

A reference to Dr. Stapf's masterly enumeration of the Gramineæ, in Vol. VII. of the 'Flora Capensis,' shows that there are some 130 species of grasses recorded as occurring in the Transvaal. These represent 50 genera, or less than half of the 103 genera recorded for the whole South African flora, which includes the desert region of the Karroo and the subtropical coast region of Natal. Of these 50 genera, 44 are represented by species apparently indigenous, four—*Arundo*, *Poa*, *Bromus* and *Lolium*—by species certainly alien, while two, *Eleusine* and *Dactyloctenium*, may perhaps be considered doubtfully indigenous.

The limited number of alien species (only about seven) is remarkable as compared with the number found in such new countries as Cape Colony and California. This is due not only to the isolation of the Transvaal, with no coast-line and separated from the Cape by the Karroo, from the Atlantic coast by the Kalahari, and from the Natal coast by the Drakensberg, but also perhaps largely to the fact that so little intercourse has been held between its inhabitants and those of adjacent regions.

Fortunately for the horticulturist, all kinds of alien weeds are at present scarce.

This state of things can not be expected to last much longer, however, and we shall look for several more alien genera of grasses, with many additional species, to become naturalized within a short period. Judging by analogy, and with the instance of the plateau stock-ranges of the Pacific states of North America fresh in mind, it can scarcely be otherwise. With the introduction of thousands of head of cattle from Cape Colony, Madagascar, Europe and Texas, and of thousands of bags of seed-grain from Texas, Argentina, Algeria, Europe and Cape Colony, it would be remarkable if aliens were not largely introduced. Already at least two species of grasses, *Poa annua* and *Sorghum halepense*, have become naturalized in the Transvaal, apparently in the short time since the most recent of the material embodied in Dr. Stapf's paper was collected.

The following species, already established in South Africa, are to be expected as additions to the alien flora of the Transvaal, before very long: *Lolium multiflorum, Hordeum murinum, Bromus maximus, Bromus commutatus, Bromus arvensis, Bromus patulus, Vulpia myuros, Vulpia bromoides, Briza minor, Briza maxima, Dactylis glomerata, Aira caryophyllea, Holcus lanatus, Cynosurus echinatus, Lamarckia aurea, Phalaris minor, Tragus racemosus, Panicum crus-galli, Avena fatua* and *Avena sterilis*.

Far more remarkable and interesting than the scarcity of alien grasses is the distribution of the fifty genera among the eighteen tribes of Dr. Stapf's classification. One of the most interesting points is the fact that nineteen of the genera belong to the two closely related tribes Andropogoneæ and Paniceæ; of the eleven South African genera of Andropogoneæ and eleven genera of Paniceæ, ten and nine respectively are represented by species indigenous to the Transvaal. Of the tribe Chlorideæ, nine of the twelve South African genera are represented, while all of the four genera of Eragrosteæ and the three of Arundinelleæ occur.

On the other hand, we find that the tribe Aveneæ, with thirteen genera in South Africa, is represented in the Transvaal collections by a *single species* only. The Hordeæ with five genera, the Agrosteæ with four, the Phalarideæ and Bambuseæ with two, the Phareæ with one, are not represented by a single indigenous species, while the large tribe Festuceæ, with twenty genera (eighteen indigenous and two alien), has only four native genera and five native species, with two alien genera and two alien species. The Stipeæ, with three genera, is represented by only one,

Aristida, but of this there are ten species recorded from the region.

To gain a general idea of the grass flora of the Transvaal, it is well to note the genera containing the largest number of species. We find the following figures:

Eragrostis	has	23	species.
Andropogon	"	16	"
Panicum	"	12	"
Aristida	"	10	"
Setaria	"	6	"
Trichopteryx	"	4	"
Pennisetum	"	4	"
Sporobolus	"	4	"
Digitaria	"	3	"
Microchloa	"	3	"

Seven genera have only two species each.

Thirty-four genera are only represented by a single species. These include the well-known North American genera *Paspalum, Bromus* and *Poa,* all three represented by alien species. It is probable that native species of *Paspalum* will be found in some parts of the Transvaal.

In these notes I have used the word species in a broad sense, for convenience, enumerating as species some of Dr. Stapf's varieties.

Of the four largest genera, three—*Andropogon, Panicum* and *Aristida*—are well known to North American botanists, being prominently represented in the North American grass flora. With the exception of this apparent connection, which may not be as real as apparent, there is little or no relationship between the two floras.

Certain well-known North American genera, such as *Rottbaellia, Stenotaphrum, Kœleria, Trisetum, Avena, Danthonia, Agrostis, Calamagrostis, Stipa, Oryzopsis, Tragus, Spartina, Phalaris, Melica, Panicularia Puccinellia, Festuca, Poa, Bromus, Lepturus, Agropyron* and *Hordeum,* all of which occur in South Africa, are not represented by a single species indigenous to the Transvaal, and only two of these, *Poa* and *Bromus,* by alien species.

Three of the largest genera of South African grasses, *Danthonia* with twenty-five species, *Ehrharta* with twenty-five and *Pentaschistis* with thirty-eight, have not, so far, been found in the Transvaal collections.

With regard to the relative proportion of individuals, a very rapid reconnoissance of the high veldt made during early winter before the grasses had lost their inflorescences, showed that *Andropogons,* and perhaps in places *Anthistirias,* are the most characteristic grasses throughout the high veldt. Other genera are represented by scattered individuals or by relatively small colonies restricted by peculiar edaphic conditions.

From what little I have so far seen of the bush veldt and the low country, it would appear that grasses are almost as abundant there as on the high veldt, but there they cease to form so characteristic a feature of the vegetation because of the abundance and prominence of the bushes and trees.

Bermuda grass (*Capriola dactylon*) is widely distributed along roadsides, in lawns, in cattle kraals and on town lands where the oxen are outspanned, but it does not have the aspect of an indigenous grass. On the open veldt it is usually found at outspanning places, and covering old and deserted ant-heaps, but the patches are rarely connected. It is highly valued as a pasture grass and is closely eaten down by mules. The Boers state that it is readily introduced into the veldt by grazing closely with sheep.

The reed (*Phragmites vulgaris*) is common along almost every stream that I have crossed, from the sources of the Limpopo on the high veldt to the Mooi, Malmanie and Marico in the west, not far from Mafeking, and to the falls of the Koomatie at Koomatiepoort on the frontier of Portuguese East Africa. It has been called a distinct species by some writers, but Dr. Stapf does not consider it worthy of even varietal rank.

The adaptation of the vegetation to peculiar climatic conditions—a literally rainless winter season of four to five months (May to September inclusive) and a fair rainfall (twenty-five to thirty inches) during the rest of the year—is interestingly demonstrated by the development of the bulb-, corm- and tuber-producing habit. This is not confined to the families Amaryllidaceæ and Iridaceæ (which are well

represented), but extends to a remarkable extent to the Asclepiadaceæ and also to the Leguminosæ; probably other families are also affected. It seems likely that in the Transvaal this development enables the plant the better to survive adverse temporarily xerophytic conditions. It is particularly noticeable here that these plants are among the first to flower in the spring, and that many—I am not yet able to say with certainty, most—of them flower without a drop of rain having fallen for four or five months, and on dry hillsides where they are not affected by any subirrigation. It is true that there has been some heavy dew, but in some of these instances not enough to make the grasses and annuals start growth. As I write there are Liliaceæ, Iridaceæ and Asclepiadaceæ in bloom on some of the driest ridges of the high veldt, where scarcely a new blade of grass is to be found. It must not be inferred from this, however, that there is no green grass at this season. On areas of burned veldt the new growth of grass is in many cases quite perceptible even without any rain, perhaps owing to the effect of heavy dews.

JOSEPH BURTT DAVY.

BRAIN-WEIGHTS OF BROTHERS.

IN a former number of SCIENCE (XVII., No. 430, p. 516) the writer cited several brain-weights of brothers and sisters, mostly children. After the recent execution by electricity of the three Van Wormer brothers, the following data were obtained at the post-mortem examination:

	Willis.	Burton.	Fred.
Age	27	23	21
Stature (centimeters)	172.8	178.0	175.2
Head length	18.2	19 1	19.1
Head breadth	15.1	15 1	16.0
Cephalic index	82.9	79.0	83.7
Head circumference	53.3	54.1	56.1
Body-weight (estimated)	140 lbs.	145	150
Fresh brain-weight	1,340 gms.	1,358	1,600

The high weight of Frederick's brain occasioning some comment, it was again weighed after about five minutes' drainage, the second figure being 1,590 gms. The left hemicerebrum weighed 3 gms. more than the right in Willis's and 10 gms. less in Burton's, while in Frederick's case the two halves weighed exactly the same.

The physiognomy of the cerebral gyral conformation of the three brains is quite similar in some respects.

A full report will be published later. There was a well-marked postorbital limbus on the left side in Frederick's brain.

E. A. SPITZKA, M.D.

RECENT ZOOPALEONTOLOGY.

SCHLOSSER'S LITERATURBERICHT.

DR. MAX SCHLOSSER, of Munich, continues his invaluable 'Literaturbericht' up to the close of the year 1900, and sends it to us as an abstract from the *Archiv für Anthropologie,* Bd. XXVIII. Like all the previous numbers of this review, which began in 1883, this is most welcome not only because our attention through it is directed to the entire literature, but because of the original critical notes which the author adds to the various abstracts which he presents.

AMERICAN OLIGOCENE MICROFAUNA.

IN the White River formation near Pipestone Springs, western Montana, Mr. Earl Douglass discovered a very interesting microfauna. The American Museum of Natural History in 1902 visited the same locality and secured a rich collection of small mammals, especially important because the *Titanotherium* beds of South Dakota have yielded only the large mammals of the period. The collection is described by Dr. W. D. Matthew* as including one marsupial allied to *Didelphys,* three Insectivora, including two new genera of an extremely primitive type, two species of Creodonta, two of Carnivora related to the dogs and mustelines respectively and six species of rodents. Among the horses is the primitive *Mesohippus westoni,* older in type than *Mesohippus bairdi.* The Artiodactyla are also represented by a variety of small forms. In this connection may also be

* 'The Fauna of the *Titanotherium* Beds of Pipestone Springs, Montana,' *Bull. Amer. Mus. Nat. Hist.*, Vol. XIX., 1903, art. VI., pp. 197–226.

mentioned the small fauna of the lower Pleistocene which has been found in caves of California and in fissure deposits in northern Arkansas, which promise to give us a nearly complete knowledge of the Lower Pleistocene microfauna of North America.

TRIASSIC REPTILIA.

THE comparatively little known Reptilia of the Trias are now receiving more attention. Von Huene* has published in *Palæontographica* quite an elaborate review of all the Triassic reptiles, including also the large amphibian Stegocephala of the Lower Trias as well as the South African forms.

Dicynodonts.—Dr. R. Broom† is contributing a series of very important papers on the South African Dicynodonts. One of the first of these, on the structure and affinities of *Udenodon,* appeared in 1901. In this genus as well as in *Dicynodon* he finds marked sexual characters or differences between the supposed males and females in the structure of the canine teeth and the massiveness of the lower jaw.

Theriodonts.—Among the Theriodonts the same author‡ finds two widely different types of palatal structure and he selects *Scylacosaurus* as the type of a new order, Therocephalia, to include the most primitive of the Theriodonts. It is possible that the higher typical Theriodonts, such as *Galesaurus* and *Cynognathus,* are descended from the Therocephalians; but the gap between the two is very great.

From Aliwal North he records§ a very surprising discovery of the lower jaw of a small mammal which is named *Karoomys Browni,* probably the oldest mammalian jaw which has yet been discovered. The jaw, although of greater geological age, remotely suggests that of *Microconodon* from our Upper Triassic. The angle is well developed and but very slightly inflected. The author considers that its nearest allies are probably to be found among the Jurassic forms, such as *Diplocynodon* Marsh.

Vomer and Prevomer.—Another paper by the same author on the mammalian and reptilian vomerine bones* advances the theory that the true vomer in mammals is represented by the parasphenoid of Huxley, a very large element in the Ichthyopsida and reduced or wanting in the Sauropsida. It is maintained further that the so-called vomers of reptiles are entirely distinct elements, to which the name 'prevomer' should be given. These are represented by the 'dumb-bell bone' of Monotremes, and by vestigial elements in Cheiroptera. The true mammalian vomer is a single median element developed between the united trabeculæ, while the Sauropsidan prevomer is a paired element formed in connection with the nasal capsules. Both elements exist in the Amphibia, and in general the prevomers are enlarged and the vomers reduced in Reptilia, while in Mammalia the prevomers are reduced and the vomers enlarged.

The same author† transfers the genus *Procolophon,* which has always been considered related to the solid-skulled Cotylosauria, to a group related to *Sphenodon* with two distinct temporal arches.

CRETACEOUS REPTILES.

Mosasaurs.—Baron Franz Nopcsa, Jr.,‡ traces the great marine lizards, or Mosasaurs, back to the Aigialosaurs, which differ from Mosasaurs only in not being so thoroughly adapted to pelagic life. These reptiles, which were found in the Lower Cretaceous of Dal-

*Uebersicht über die Reptilien der Trias,' *Palaeontographica*, 1902, pp. 1–84, tab. I.–IX.

†'Remarks on Certain Differences in the Skulls of Dicynodonts, Apparently due to Sex,' *Proc. Zool. Soc. Lond.*, June 3, 1902.

‡'On the Structure of the Palate in the Primitive Theriodonts,' *Geol. Mag.*, Decade IV., Vol. X., No. 470, August 1903.

§'On the Lower Jaw of a Small Mammal from the Karoo Beds of Aliwal North, South Africa,' *Geol. Mag.*, December IV., Vol. X., No. 470, August, 1903.

*'On the Mammalian and Reptilian Vomerine Bones,' *Proc., Linnean Soc. of New So. Wales*, 1902, Pt. 2, October 29.

†'On the Remains of *Procolophon* in the Albany Museum,' *Records of the Albany Museum*, Vol. I., No. 1, p. 8.

‡'On the Origin of the Mosasaurs,' *Geol. Mag.*, Decade IV., Vol. X., No. 465, p. 119, March, 1903.

matia, show a strong relationship to the living monitor lizards, differing from them only in those adaptive features in which they approach the Mosasaurs. Still farther back he hypothecates a terrestrial Jurassic type, of which the Cretaceous Mosasaurs and recent Monitors are the offspring. The author was not aware that Dr. Louis Dollo,* of Brussels, had already presented a similar theory in 1892—apparently another case of independent discovery. Baron Nopcsa has presented also recently a number of interesting memoirs upon the Iguanodontia.

Plesiosaurs.—After having exhaustively studied the North American Mosasaurs, Professor S. W. Williston has begun to monograph the North American Plesiosaurs, his first complete paper, 'North American Plesiosaurs, Part I.,' appearing from the Field Columbian Museum last April. This part is devoted first to an exhaustive description of the remarkably preserved type *Dolichorhynchops osborni* discovered by Sternberg in the chalk of Logan County, Kansas, and now mounted in the museum of Kansas University. Its most distinctive feature is the great elongation of the snout correlated with a relatively abbreviated neck. The author finds that the Plesiosaurs, like the Mosasaurs, were divided into a number of independent but contemporaneous phyletic series, the distinctive characters of which are chiefly found in the structure of the shoulder girdle, in the proportions of the neck and of the skull. All the Plesiosaur materials in the American Museum of Natural History have been placed at the author's disposal for study, and the Carnegie Institution has made a special grant for the continuation of this research.

JURASSIC REPTILES.

Compsognatha.—Franz v. Nopcsa† has restudied the type and other specimens of *Compsognathus* from the Jurassic of Solenhofen. He has made a special examination of the so-called 'embryo' discovered by Marsh in the body cavity of the Munich type; and he comes to the conclusion that this supposed embryo is the skeleton of a small lizard. Osborn* has recently described a supposed bird-catching Dinosaur found in the Como beds of Wyoming and now mounted as a remarkably complete skeleton in the collection of the American Museum of Natural History. This type probably belongs to the same subdivision of the Carnivorous Dinosaurs as *Compsognathus,* namely, the Compsognatha of Huxley, distinguished by hollow vertebræ in contrast with the solid hour-glass-shaped vertebræ of the Megalosauria. *Ornitholestes* is particularly distinguished by three very long, slender fingers on the manus, the other fingers being reduced, hence the supposition that it was adapted to grasping a slender and agile prey such as the Jurassic birds.

Sauropoda.—Our knowledge of the Sauropoda, or amphibious Dinosaurs, is being enriched by descriptions of remarkably complete specimens of *Brontosaurus* in the Field Columbian, Carnegie and American Museums. Dr. E. S. Riggs has briefly described the former and is now preparing an elaborate paper. Mr. J. B. Hatcher is describing the Carnegie Museum skeleton. In the American Museum of Natural History, an exceptionally large skeleton of *Brontosaurus,* discovered in 1898, is being restored and mounted complete. In the Yale University Museum the pelvis and hind limbs of the still more perfect type skeleton of *B. excelsus* have recently been mounted under the direction of Professor C. E. Beecher.

Mr. Hatcher† shows that *Pleurocœlus nanus* Marsh, the smallest of the Sauropoda, is identical with *Astrodon johnsoni* Leidy, and is closely related, as Marsh pointed out, to remains found in Jurassic deposits near Havre, Normandy.

* 'Les Ancêstres des Mosasauriens,' *Bulletin Scientifique de la France et de la Belgique,* extr. du Tome XXXVIII.

† 'Neues über *Compsognathus,*' Sep.-Abdr. a. d. *Neuen Jahrb. f. Miner., Geol. u. Palaeont.,* Beilage-Band XVI., 1903, S. 476–494.

* '*Ornitholestes hermanni,* a New Compsognathoid Dinosaur from the Upper Jurassic,' *Bull. Amer. Mus. Nat. Hist.,* Vol. XIX., 1903, art. XII., pp. 459–464.

† 'Discovery of Remains of *Astrodon* (*Pleurocœlus*) in the Atlantosaurus Beds of Wyoming,' *Ann. Carnegie Museum,* Vol. II., 1903, pp. 9–14.

From the famous quarry of Cañon City, Colorado, the same author* describes a new Sauropod, *Haplocanthus priscus,* distinguished by simple neural spines in the posterior cervical and anterior dorsal vertebræ, thus totally unlike either *Camarasaurus, Brontosaurus* or *Diplodocus.* The author regards it as the most generalized member of this order yet discovered in America, but that it is a member of this order he believes is clearly shown in the structure of the pelvis and by other characters exhibited by the vertebræ, its nearest affinities being to the Morosauridæ.

H. F. O.

SCIENTIFIC NOTES AND NEWS.

The following is a list of those to whom the Royal Society has this year awarded medals: The Copley medal to Professor Eduard Suess for his eminent geological services, and especially for the original researches and conclusions published in his great work 'Das Antlitz der Erde.' A royal medal to Sir David Gill for his researches in solar and stellar parallax, and his energetic direction of the Royal Observatory at the Cape of Good Hope. A royal medal to Mr. Horace T. Brown for his work on the chemistry of the carbohydrates and on the assimilation of carbonic acid by green plants. The Davy medal to M. Pierre and Madame Curie for their researches on radium. The Hughes medal to Professor Wilhelm Hittorf for his long continued experimental researches on the electric discharge in liquids and gases.

Lord Kelvin received the degree of D.Sc. from the University of Wales on the occasion of the Court of November 13.

The Royal Asiatic Society has conferred its triennial medal on Sir William Muir, lately principal of the University of Edinburgh.

Dr. Henry S. Pritchett, president of the Massachusetts Institute of Technology, has resumed his official duties after a brief foreign visit.

Professor Geo. F. Atkinson, of Cornell University, returned to America on November 14, after having made a study of fungi in various European collections.

Dr. L. McI. Luquer, of the department of mineralogy of Columbia University, has obtained leave of absence and will sail for Europe early in February.

Dr. R. D. Murray, of the U. S. Marine Hospital Service, who has been at Laredo, Texas, combating the epidemic of yellow fever, has been seriously injured as the result of a runaway accident.

Mr. Ambrose Swasey, of Cleveland, Ohio, has been nominated for president of the American Society of Mechanical Engineers. The society will hold its annual meeting in New York, beginning on December 1, when the president, Mr. James M. Dodge, will deliver the annual address, the subject being 'The Value of an Engineering Education to a Young Man.'

Mr. R. K. Kaye Gray gave the presidential address before the British Institution of Civil Engineers on November 12.

Dr. Otto Augustus Wall has completed his thirtieth year as professor of materia medica and botany in the St. Louis College of Pharmacy. On the evening of November 14, the graduates of the institution presented the college with a life-size medallion of Professor Wall, and a duplicate medallion was presented to his family. The presentations were accompanied by appropriate exercises, followed with a banquet tendered Professor Wall by the Alumni Association.

Professor W. M. Scott, formerly state entomologist (and pathologist) of Georgia, Atlanta, Ga., has resigned to accept a position as pathologist in the Bureau of Plant Industry, U. S. Department of Agriculture. He has already entered upon his new duties, which relate to diseases of orchard fruits. Professor Wilmon Newell, formerly of Iowa, recently of the Texas Agricultural College, has been appointed as state entomologist of Georgia to fill the vacancy caused by Professor Scott's resignation.

*'A New Sauropod Dinosaur from the Jurassic of Colorado,' J. B. Hatcher, *Proc. Biol. Soc. Washington,* February 21, 1903, Vol. XVI., pp. 1–2.

DR. CHARLES J. MARTIN, F.R.S., formerly professor of physiology at the University of Melbourne, who was appointed director of the Lister Institute of Preventive Medicine some months ago, has now taken up his duties.

MR. WILLIAM ROSCOE THAYER has undertaken, at the request of Mr. Fiske's family, to edit the letters of the late John Fiske. He earnestly requests that persons having any of Mr. Fiske's letters will send them, or copies of them, to No. 8 Berkeley St., Cambridge, Mass.

A LECTURESHIP has been endowed in the University of Birmingham by an anonymous friend in memory of the life and work of the late Professor Huxley. Sir Michael Foster has been invited to give the first lecture.

A PROJECT has been started to found at Peterhouse, Cambridge, a prize for physics in memory of Professor Tait, of Edinburgh, for many years a fellow, and at his death an honorary fellow, of the college.

THE weekly assembly exercises of November 18 at the State University of Iowa were devoted to a memorial service in honor of Dr. Frank Russell, of Harvard University, whose untimely death we have recorded. Impressive addresses were delivered by Dr. Samuel Calvin, Professor A. G. Smith and Professor C. C. Nutting. A letter was also read from Professor F. W. Putnam, of the Peabody Museum. Dr. Russell was a graduate of the University of Iowa with the class of 1892 and conducted his first scientific explorations in the far north under the auspices of that institution.

DR. HENRY CARRINGTON BOLTON, well known as a chemist and bibliographer, died at Washington on November 19 in his sixty-first year.

PROFESSOR ARTHUR ALLIN, B.A. (Toronto), Ph.D. (Berlin), since 1897 head of the Department of Psychology and Education in the University of Colorado, at Boulder, died on November 17, of typhoid fever. Dr. Allin had given much time recently to the study of sociological problems viewed from the psychological standpoint.

DR. GEORGE J. ENGELMANN, of Boston, an eminent physician and gynecologist, son of the well-known botanist, died on November 16 from pneumonia at the age of fifty-six years.

MR. J. STANLEY GRIMES, a writer and lecturer on scientific subjects, especially on the physiology of the brain, died at Evanston, Ill., on October 1, at the age of ninety-six years. Mr. Grimes had been a fellow of the American Association for the Advancement of Science since 1874.

WE regret also to record the deaths of Sir Charles Nicholson, Bart., who practised medicine in Sydney, and was the first chancellor of the University of Sydney, on November 8, in his ninety-fifth year; of Dr. Nabel, professor of geodesy in the Technological Institute of Dresden, aged eighty-three years; of Dr. Otto Nasse, formerly professor of physiological chemistry in the University of Rostock, at the age of sixty-four years, and of Dr. G. R. Dahlander, professor in the Technological Institute of Stockholm.

DR. GEORGE R. TABOR, Texas State Health Officer, proposes to extend invitations to Surgeon General Wyman and the representatives of the Health Departments of Louisiana, Mississippi and Alabama to accompany him to Mexico next January for the purpose of holding a conference with the Superior Board of Health of that country to determine upon a concerted plan of action that would prevent another epidemic of yellow fever in Mexico and the spread of the disease to Texas and the south.

THE scientific mission under the charge of Drs. Todd and Dutton, which has been despatched to Central Africa under the auspices of the Liverpool School of Tropical Medicine, has arrived at Boma. The object of the mission is to study the pathology of various tropical maladies, including sleeping sickness.

The British Medical Journal states that Lieutenant-Colonel Bruce, F.R.S., who returned from Uganda some weeks ago, has established by experiments conducted in conjunction with Dr. Nabarro and Captain Grieg, I.M.S., two important points. The first is that monkeys inoculated with the cerebro-spinal fluid of patients suffering from sleeping sickness, or with blood from natives not yet

showing the symptoms of the disease, but containing a similar parasite, subsequently present all the symptoms of the disease; the second is that the disease is limited to districts of South Africa within which the particular tsetse fly, *Glossina palpalis*, occurs, and that where this fly does not occur sleeping sickness is absent. The evidence, therefore, to connect sleeping sickness, with the presence of trypanosomes in the cerebro-spinal fluid is now apparently very strong.

UNIVERSITY AND EDUCATIONAL NEWS.

Mr. John D. Rockefeller has offered to give Vassar College $200,000, or such part of this sum as may be equaled by gifts from other sources before June 1904. $50,000 has so far been subscribed, and an appeal is made for further gifts.

The building of the Medical Department of Northwestern University was injured by fire on November 20, the loss being estimated at $10,000.

The Association of Colleges and Preparatory Schools of the Middle States and Maryland will hold its seventeenth annual convention at Columbia University, New York, on November 27 and 28. Dr. Ira Remsen, president of the Johns Hopkins University and of the association, will give an address entitled 'Some Unsolved Educational Problems.' The subjects for discussion are 'The Elective System and Secondary Schools,' 'What Should be the Length of the College Course?' and 'Athletics in Schools and Colleges.' On Saturday an Association of Mathematicians of the Middle States and Maryland will be organized.

It is reported that there is an outbreak of typhoid fever both at Brown University and at Williams College.

The University of Liverpool was formally inaugurated on November 7. Addresses were made by the Lord Mayor of Liverpool, Lord Derby, Vice-chancellor Dale and Sir Oliver Lodge.

A memorial has been addressed to the General Board of Studies at Cambridge urging that increased opportunities for study in anthropology be offered at the university.

Professor John A. Brashear has resigned the chancellorship of the Western University of Pennsylvania.

President Howard Ayres, for the last four years president of the University of Cincinnati, has been deposed from that office by a majority vote of the board of trustees. He will retain the position until the close of the academic year.

The following appointments have recently been made in the Massachusetts Institute of Technology: Leslie Rogers Moore, S.B., Arthur-Alphonzo Blanchard, Ph.D., Livingston W. Smith, Ph.D., instructors in inorganic chemistry; Frank Baldwin Jewett, Ph.D., William Otis Sawtelle, S.B., instructors in physics; Percy Goldthwaite Stiles, Ph.D., instructor in physiology and personal hygiene; Wilfrid Evart MacDonald, A.B., Burton H. Camp, A.B., instructors in mathematics; Eugene Stillman Foljambe, S.B., James Russell Putnam, S.B., instructors in mechanical drawing and descriptive geometry; Winfield C. Towne, A.B., instructor in gymnastics.

Dr. J. N. Langley, F.R.S., fellow of Trinity College, has been elected to the professorship of physiology at the University of Cambridge, vacant by the resignation of Sir Michael Foster.

The board of Trinity College has elected Dr. Sydney Young, F.R.S., Dublin, professor of chemistry in University College, Bristol, to the chair of chemistry vacant by the resignation of Professor Emerson Reynolds.

Dr. W. G. Smith, M.A., who was appointed last year to the recently established lectureship on experimental psychology at King's College, London, has resigned to accept a similar position at the University of Liverpool. The council of King's College has elected to the post Dr. C. S. Myers, M.A., of Cambridge. Dr. Smith was some time since instructor at Smith College, and Dr. Myers has recently visited the psychological laboratories of the United States.

Dr. Wilhelm Wörtinger, of Innsbruck, has been appointed professor of mathematics in the University of Vienna, and Dr. A. Partheil, associate professor of chemistry at Bonn, has accepted a similar position of Königsberg.